The effects of *ac* potentials on the crystallography of noble metals

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The surface of a solid is the intrinsic defect of a crystal. As a consequence, surface atoms tend to minimize their free energy by lateral displacements to more stable positions. It was found that the application of low-frequency-*ac* potentials to noble metals produce a redistribution of crystallographic planes. These effects disapear after a few cycles in the oxide region. Two *ac* potentials were used;

Program 1): ϕ_1 = 0.05 V, ϕ_2 = 0.50 V, v = 10 Hz
Program 2):ϕ_1 = 0.65 V, ϕ_2 = 1.50 V, v = 25 Hz

An original polycrystalline (*pc*) platinum surface shows *XRD* patterns with a great contribution of the (220) plane (78 % integrated signal) and the (311) plane (8 %). When *Program 1)* is applied to *pc* platinum, *XRD* patterns exhibit a larger contribution of (200) planes (Fig.1). On the other hand, the application of *Program 2)* produces an increase of (111) planes (Fig. 2).

Platinum-atom-displacements in the lattice can be calculated from the expression of the dynamical matrix modified with the *ac* potential.

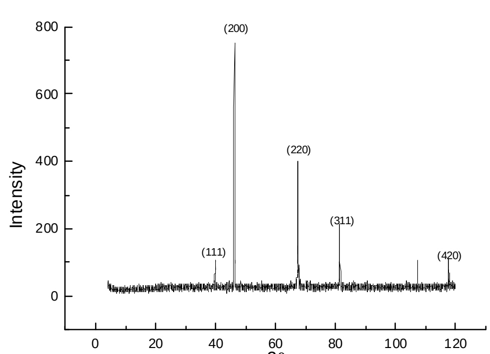
$$M\omega^2 \varepsilon_{\mathbf{j}} = \mathbf{D}(\mathbf{k})\varepsilon_{\mathbf{j}} + (e\phi_i/r)\cdot\varepsilon_{\mathbf{j}} \qquad (1)$$

Being ε_j the components of the polarization vector with **k** of the first Brillouin zone, ω the vibration frequency, **D(k)** the dynamical matrix of the interionic forces, and $\phi_i(t)$ the *ac* potential.

There are two solutions for the motion eq. (1), which are evaluated within the two halfperiods of the *ac* potential. In both cases, the original planar waves that describe the vibration of platinum atoms in the lattice are reduced to single longitudinal vibrations during the application of the *Program*. As a consequence, a linear atomic displacement occurs, which destroys the original crystalline orientation. This effect results in a new crystallography. The new equilibrium position, *r´*, can be obtained from the potential energy and its derivation with respect to *r´*,

$$r' = r\sqrt{\frac{\phi_2}{\phi_1}} \quad with \quad \phi_2 > \phi_1 \qquad (2)$$

Figure 1.- *XRD* patterns of a platinum plate treated with *Program 1.* The X-ray diffractions were obtained with a step size of 0.02º and 0.5 s of time per step



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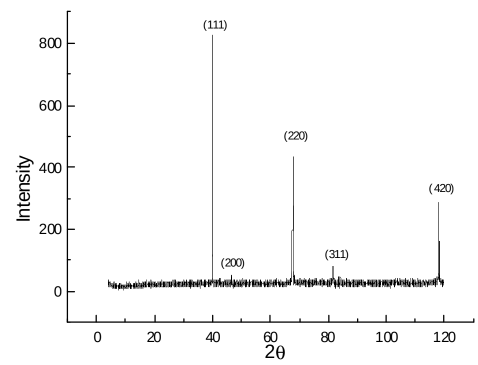

Figure 2.- *XRD* patterns of a platinum plate treated with *Program 2.*